

Relationship between resting VO_{2max} consumption, functional independence, and physical activity levels in mothers of children with immobile cerebral palsy

Resting VO_{2max} consumption in cerebral palsy

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Abstract

Aim: In the current literature, there is no study investigating the relationship between oxygen consumption in children with Cerebral Palsy (CP) and the physical activities of their parents. In this study, we aimed to investigate the relationship between resting VO_{2max} consumption and functional independence and physical activity levels in mothers of children with immobile CP.

Material and Methods: Thirty cerebral palsied cases (F:16, M:14) with a mean age of 6.63 ± 2.68 years (3-12 years) were included in the study with their mothers. Registration forms were filled out for each case. Children were evaluated with the Functional Independence Scale for Children (WeeFIM). Resting VO_{2max} measurements were performed with the Cosmed Fitmate Pro™ device. International Physical Activity Questionnaires (IPAQ) were completed for mothers. **Results:** There are no statistically significant differences between the mean resting VO_{2max} values of quadriplegic and diplegic CP cases ($p > 0.05$), and there are no statistically significant differences in mean resting VO_{2max} values of the cases with CP in terms of gender ($p > 0.05$). There is a significant correlation between resting VO_{2max} values of patients with CP and their mothers' physical activity levels ($p < 0.05$). Likewise, there is a significant correlation between functional independence levels in daily living activities of patients with CP and their mothers' physical activity levels ($p < 0.05$).

Discussion: Physical activity levels of mothers with CP are lower in all areas compared to mothers who do not have a disabled child. Resting VO_{2max} values and functional independence of children with CP are better in mothers with high physical activity levels.

Keywords

Cerebral palsy; Physical activity; Functional independence; Oxygen consumption

DOI: 10.4328/ACAM.20452 Received: 2020-12-23 Accepted: 2021-02-01 Published Online: 2021-02-10 Printed: 2021-07-01 Ann Clin Anal Med 2021;12(7):809-813

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Introduction

Cerebral Palsy (CP) is a permanent disorder of motor function, posture and movement development that occurs due to a non-progressive lesion in the brain in the maturation period, but can change with age and cause limitations in activities. Sensory, cognition, communication, perception, epilepsy, behavioral disorders and secondary musculoskeletal problems may accompany this motor disorder [1]. As a result of all these problems, children's functional independence levels may decrease in daily life [2]. Some cases with CP may also be immobile due to these problems [3]. As a result, problems such as a decrease in muscle strength and mass, decrease in bone mineral density, various orthopedic problems and decrease in resting VO_{2max} may occur secondary to immobilization [4-6]. Alterations of the central nervous system, which produce the characteristic features of CP, result in functional deviations that require greater oxygen consumption than typical functions. For this reason, oxygen consumption can be considered a useful tool for the assessment of functional ability, because its interpretation provides an indication of endurance, fatigue and ability to accomplish routine daily tasks. Then, quantification of the oxygen consumed while resting and doing daily tasks can provide objective data in order to help evaluation of patients with walking and other locomotor system disabilities and help assess the effectiveness of therapeutic interventions, such as ambulatory aids, orthotic prescriptions, physical therapy or surgery [7].

VO_{2max} is the maximum level of O_2 usage per minute in liters with exercise. Resting VO_{2max} is the maximum O_2 usage level per minute by a person in a sitting position and resting state without any physical activity [8]. Resting VO_{2max} can provide information with physical activities [9].

It has been shown that the contribution of parents in the process of caring for a child with CP is important in the treatment process and affects the success of rehabilitation [10]. There are studies showing that the inclusion of parents in the treatment process increases success [11]. However, in the current literature, there is no study investigating the relationship between the resting VO_{2max} consumption by a child with CP and the physical activity levels of the parents.

The aim of this study is to investigate the relationship between resting VO_{2max} consumption and functional independence and physical activity levels in mothers of children with immobile CP.

Material and Methods

This study was conducted at Firat University Hospital and was done in March 2020. The study, which was conducted according to the principles stated in the Declaration of Helsinki, was ethically appropriate and it was decided by Firat University Non-Invasive Research Ethics Committee with the number of 97132852/050.01.04.

Study Design and Cases

This study is a prospective and cross-sectional study. Thirty children and their mothers who met the inclusion criteria were included in the study. While the inclusion criteria for the study were diagnosis of CP in children, the ages from 2 to 18, and the inability to provide independent ambulation, the exclusion criteria were the presence of another neurological disease and

the presence of a disease that would affect resting oxygen consumption. For mothers, the inclusion criterion was living with the child, while the exclusion criterion was the presence of any disease that could affect the level of physical activity. Participation in the study was voluntary, and consent forms were obtained from all subjects for participation in the study. Thirty cases (F:16, M:14) whose mean age was 6.63 ± 2.68 years (min-max: 3-12 years), were included in the study with their mothers.

A registration form containing various clinical and demographic data was filled in for the cases with CP included in the study, and they were evaluated with the Functional Independence Scale for Children (WeeFIM). Then, resting VO_{2max} measurement was performed with the Cosmed Fitmate Protm device. The International Physical Activity Questionnaire (IPAQ) was completed by the mothers of the cases. The data obtained were analyzed.

Evaluations

Demographic Data Form

Demographic data forms were filled in, containing the age, height, weight, gender and clinical type of the children with CP and the maternal age.

Resting VO_{2max} Measurement

The measurements were made with the Cosmed Fitmate Protm device. Before taking the measurement, the children were kept in a sitting position for at least 20 minutes. Afterwards, resting VO_{2max} was measured for 10 minutes. The highest VO_2 value seen in this 10 minute period was recorded. Care was taken to ensure that the children did not exercise heavily in the last 24 hours before the time of measurement and their sleep patterns were not disturbed. Figure 1 shows the Cosmed Fitmate Protm device and the application position for resting VO_{2max} measurement (available at: www.cosmed.com/en/products/cardio-pulmonary-exercise-test/fitmate-pro).

Functional Independence Measure for Children

It was created in 1993 using the Functional Independence Scale (FIM). It is a useful, short, comprehensive measurement method [12] that determines developmental, educational and social functional limitations in children with CP and other developmental disorders.

Functional Independence Measure for Children (WeeFIM) includes a total of 18 items in 6 areas: self-care, sphincter control, transfers, locomotion, communication, social and cognitive. In this sense, it is an effective measure that is widely used in the evaluation of transfers and locomotion, providing posture smoothness and balance in children with CP. While performing the function in each item in the areas evaluated, the child's abilities of whether he received assistance, on time, or whether an assistive device was required are scored from 1 to 7. A score of 1 is given when the child performs the task with a complete help, and 7 points when the child does it independently and safely. Accordingly, a minimum of 18 (fully dependent) and a maximum of 126 (fully independent) points can be obtained [13].

International Physical Activity Questionnaire

The International Physical Activity Questionnaire (IPAQ) was first developed in Geneva in 1998 in order to determine the level of physical activity that individuals reported, and in 2003,

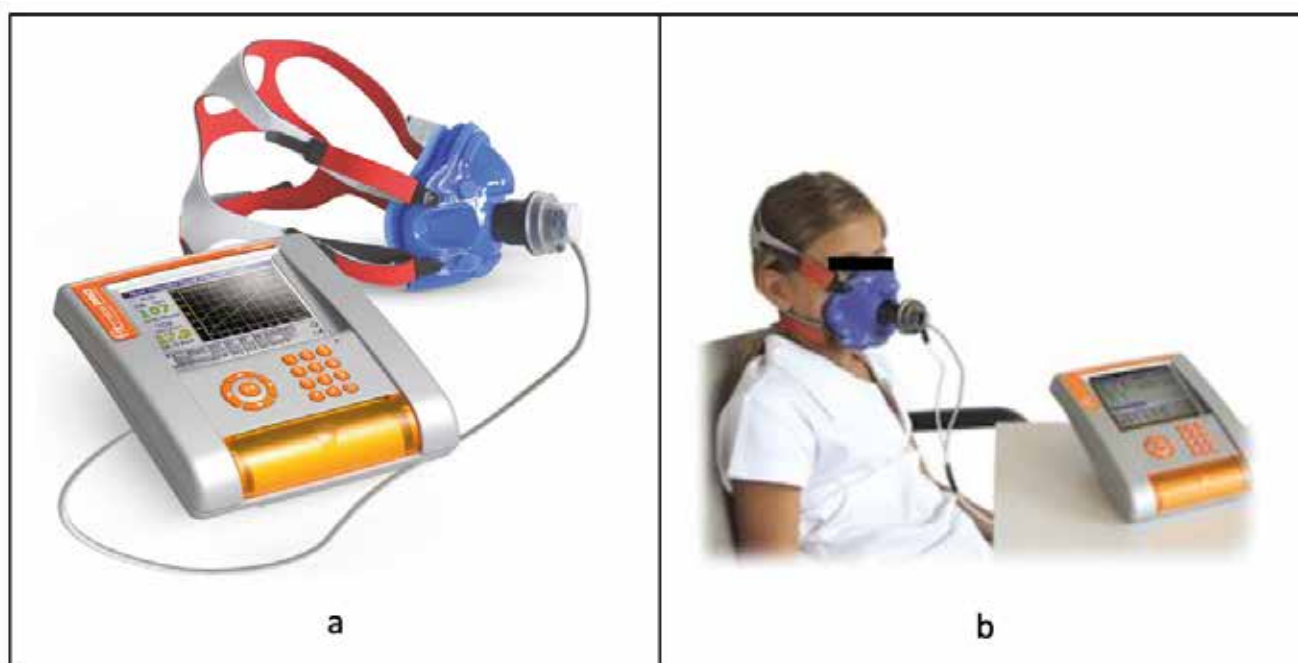


Figure 1. a) Firmate Pro™ b) Application Position

Discussion

This study is important because it is the first study investigating the relationship between resting VO_{2max} consumption in children with CP and physical activity levels of mothers. This study, which aimed to investigate the relationship between resting VO_{2max} consumption and functional independence and physical activity levels of mothers in children with immobile CP, was completed with the participation of 30 patients with CP and their mothers. As a result, the resting VO_{2max} consumption of children with immobile CP is lower than their healthy peers; It was observed that the physical activity levels of mothers were lower in all areas compared to mothers who did not have a disabled child. In addition, it was observed that children of mothers with lower physical activity levels were also more functionally dependent on daily living activities.

Consumption of VO_{2max} and resting VO_{2max} peaks between the ages of 17-21 in men, and then decreases with age. In women, it reaches its highest values between the ages of 12-15, and then decreases with age. In general, the values of VO_{2max} and resting VO_{2max} consumption of men are higher in all periods. Absolute, independent of body weight, VO_{2max} values are lower in children than in adults. When expressed in proportion to body weight, the difference with adults decreases. While the average VO_{2max} value is 50 ml/kg/min at the age of 5 in healthy boys and girls, it increases to 52 ml/kg/min in boys around the age of 9-10. In girls, it decreases to 45 ml/kg/min [17].

According to the data obtained from this study, the resting VO_{2max} values of children with CP are much lower than their healthy peers. The mean resting VO_{2max} of these patients, whose mean age was 6.63 ± 2.68 years, was calculated as 7.12 ± 1.37 ml/kg/min. Considering the fact that the cases are functionally dependent on their daily activities, it is understood that immobilization explains the low resting VO_{2max} values.

Information on the energy expended during walking by children with cerebral palsy can provide objective data to help assess ambulatory aids, orthotic prescriptions or surgical intervention

[18]. Generally, the rate of oxygen uptake is used to measure energy expenditure, but heart rate is more easily measured and has been shown in adults to be an accurate and convenient estimate of energy expenditure [19]. Heart rate has also been suggested for estimating energy expenditure by normal and disabled children [20]. It is shown previously that there is a linear relationship between heart rate and oxygen uptake over a wide range of walking speeds for normal children and for children with cerebral palsy [21].

Although the mean resting VO_{2max} value was higher in girls compared to boys, there was no significant difference between them. In this case, it can be interpreted that there is no difference in terms of gender between the resting VO_{2max} values of the CP cases between the ages of 3-12.

According to the data obtained from this study, there is no difference between the resting VO_{2max} values of quadriplegic and diplegic CP cases. Although it is expected that the physical capacity of diplegic patients is higher than quadriplegics, it is thought to be due to the greater effect of mobility on resting VO_{2max} . The fact that all of the cases included in the study were immobile prevented this difference from occurring.

The energy expenditure index based on oxygen uptake (EEI) varied with walking speed, and the EEI curve reflects the energy requirements at various walking speeds. At slow speeds, the EEI for both groups of children was high, indicating poor economy. With increasing walking speed, the EEI decreased until an optimum range of maximum economy was reached. For normal children who could walk beyond this speed, the EEI increased, reflecting less economy at the fastest speeds. This pattern was the same for both the oxygen-uptake and heart-rate indices [22].

It was observed that the physical activity levels of mothers of the cases with CP included in the study were lower in all areas compared to mothers without a disabled child [23, 24]. Having a disabled child and taking care of him has led to this situation. Caring for a disabled child with a lower resting VO_{2max}

and less functional independence in daily living activities, compared to their healthy peers, causes a decrease in the level of physical activity. Supporting this situation, according to the data obtained from this study, there is a correlation between the physical activity levels of the mothers and the resting VO_{2max} and daily living independence of their children. From another point of view, resting VO_{2max} values and functional independence of children with CP of mothers with high physical activity levels are better. Therefore, it is necessary to advise mothers to increase their physical activity levels.

A mother who is more physically active and who is aware of the importance of physical activity will also provide care to a disabled child, as the high physical activity levels of mothers can positively affect the resting VO_{2max} values of the child with CP and functional independence in daily life activities and factors such as being able to cope more easily with the burden of raising it.

The limitation of our study is that, first of all, we did not evaluate mothers' working status or weekly working hours. Secondly, in order to generalize the results, the inclusion of different types of CP and a control group consisting of healthy children and their mothers into the study could make the study stronger. In addition, the objective of the measurements and the inclusion of more cases than the number of cases determined in the power analysis are the strengths of the study.

As a result, the resting VO_{2max} values of children with CP are much lower than their healthy peers, and there is no difference in terms of gender. Likewise, there is no difference between the resting VO_{2max} values of the cases according to the quadriplegic and diplegic types of CP. Physical activity levels of mothers with CP are lower in all areas compared to mothers who do not have a disabled child. This situation was caused by having a disabled child and taking care of him. The resting VO_{2max} values and functional independence of the children with CP of mothers with high physical activity levels are better.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

Funding: None

Conflict of interest

None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.

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How to cite this article:

Fatih Tekin, Furkan Bilek. Relationship between resting VO_{2max} consumption, functional independence, and physical activity levels in mothers of children with immobile cerebral palsy. *Ann Clin Anal Med* 2021;12(7):809-813